

CLEAN COPY OF AMENDED SPECIFICATIONSet of Equipment for Aiding the Orientation of the Blind

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Technical Field

The invention relates to a set of equipment to aid the orientation of the blind. The invention includes a device attached to a carrying unit that can be attached to the surface of the body and an input unit that can be connected to the device. The device has a sensing unit and a processing unit connected to the sensing unit, the sensing unit has a CCD camera, and the processing unit is connected to a picture memory serving to store pictures, a sound memory to store sounds, and a loudspeaker suitable for emitting acoustic signals.

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Related Art

There are many types of devices today that aid the blind in moving about. Of these, there is the stick, the disadvantage of which is that the sensing distance is small. A significant aiding partner is a trained guide dog, the acquisition and keeping of which is very expensive. The general deficiencies of the known aiding devices are that they do not give information regarding the pictures and the direction of the obstacles, only their presence.

The software that is available commercially is capable of producing a relationship between pictures and sounds, but it requires a great deal of hardware. Thus, because of its dimensions and high price, it will not become a mass produced article.

Installed and portable devices are also known and have an image sensor and loudspeakers which are connected to a portable or PC-type computer. With the help of the

computer, the signals from the image forming CCD camera (that is, the sensed images) can be recorded and appropriate acoustic signals (specifically their names) can be linked to the individual images. The blind use these devices in such a way that, in the case of the recognition of pictures formed of objects positioned in a given area, the device broadcasts the name linked to the image from the loudspeaker, so that the blind are able to acquire information about the objects in their environment. Such a solution is described in the text of Masato Kawado's lecture entitled "Image Understanding for Navigation Support" (Fuzzy System International Conference, US, New York, IEEE 20/03/1995, pages 29-30; XP 000699268).

The disadvantage of the solution described in this lecture, however, is that the system that helps orientation is constructed of components with large dimensions, so that it cannot be used practically when the blind person is moving, for example, on the street or on a stairway.

Another unfavourable aspect is that the equipment only gives answers to questions asked by the person using it. In other words, it does not carry out automatic navigation, and it is only able to state whether certain objects are in the vicinity and possibly their position.

A further disadvantage is that, due to the larger dimensions, the loading of the image memory of the device is difficult, and picture and sound recording while in motion may only be carried out in a very complex manner.

Another of the disadvantages of the device is that the fixed position camera does not give the appropriate navigation possibility for the blind person moving about, so the positions of the objects in the vicinity are difficult to determine for a person in motion.

#### Summary of Invention

With the invention, our aim is to overcome the deficiencies of the known aiding devices and to create a device that supports the picture creating ability of the blind and so improves

their sureness of movement and aids better and more precise orientation of blind persons when moving, even in traffic, and while moving in other otherwise unknown outdoor areas.

Our aim is for the device to be small and for its production cost and selling price to  
5 allow it to be sold as a mass produced article.

The basis of the idea of the invention was formed by the recognition that, with the help of an optical device fixed to the head and capable of producing pictures of objects, and of comparing these with the pictures of groups stored earlier in a database by means of a  
10 computing device, a sound identifier that most closely relates to the object is selected and is played to the blind person in an audible form. In this manner, the task of carrying out the simple picture-sound transformation becomes solvable.

We recognised that, due to the development of microchips, high operating speed  
15 microprocessors and large memory capacity provide development engineers with cheap, flexible programmability in a sufficiently small size. Because of this, the implementation of simple picture-sound transformation may be solved with structural elements of a small size that may be placed on the head of blind people, specifically on spectacles-like carrying devices, and in this way, the device becomes a mass produced article, just like hearing aids, for example.

In accordance with the set aim, the equipment to aid the orientation of the blind contains a device attached to a carrying unit that can be attached to the surface of the body and an input unit that can be connected to the device. The device has a sensing unit and a processing unit connected to the sensing unit, the sensing unit has a CCD camera, and the  
25 processing unit is connected to a picture memory serving to store pictures, a sound memory to store sounds, and a loudspeaker suitable for emitting acoustic signals. The device is formed in such a way that the unit carrying the device has spectacles that can be positioned on the head of the person using it, the sensing unit's camera is fixed to the spectacles, and furthermore, the processing unit is a small sized microprocessor with an analogue input, an external bus and an

output. The processing unit has a joining module, and the camera is connected to the analogue input of the microprocessor through the joining module. The picture memory and the sound memory are connected to the external bus of the microprocessor, and with the insertion of an amplifier, the loudspeaker is connected to the output of the microprocessor.

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A further criterion of the set of equipment according to the invention is that the microprocessor, the joining module, the picture memory, the sound memory, the amplifier and the loudspeaker are fixed to the spectacles.

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In a possible version of the set of equipment, the microprocessor has a data transfer input, the writing unit has a microphone for reading in verbal information, the writing unit is temporarily connected to the data transfer input, and the microphone is temporarily connected to the data transfer input of the microprocessor.

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In a further version of the set equipment, the microprocessor has a controller part unit suitable for reading in and processing picture and sound information at the same time, the controller part unit is connected to the internal memory unit serving as a store for the picture information and to a second internal memory unit serving as a store for the sound information, and the two internal memory units are connected to an identifying unit for searching according to picture information, and also for connecting the picture and sound information.

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The set equipment has numerous advantageous features. An important advantage is that, in the brain of a person blinded in an accident, there is a kind of "picture" of the environment and the world, and so it is easier to give back the concrete pictures of the objects in their area of movement, in the area of his/her home, and in the neighbourhood by naming them.

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Those born blind participate in different training processes where, with the help of touch, feel and explanation, they carry the visible pictures of only a few objects and situations, and so for them the advantage of the device is in making use of its free programming ability so that so-called global pictures can be produced in accordance with the person's "vocabulary".

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A favourable point is that, due to the transformation of picture information to sound information in a new way and the employment of equipment of small size, recognising and identifying obstacles occurring while moving about as pictures, and then playing them as sound by means of the device guarantees a much better feeling of safety than the already realised bleeper, signalling devices, and the essentially non-portable, image recognition communications devices. Thus, the invention makes it possible for blind people to move about essentially freely, even in an unknown environment.

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Another advantage is that, on the one hand, the picture and word vocabulary of the device is programmed in a fixed way during manufacture, and on the other hand, a seeing person in the environment of the person using the device can carry out customised programming, so that the device can become language independent and be simply used anywhere in the world. Due to the dimensions and the use of the unique recording unit, it may be programmed, even while in motion.

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Another favourable feature is that the information stored in the device does not use the "usual: bmp, jpg, ..." picture storage procedures, but its unique resolution is low (64x8 bit is one picture), so that, due to the small amount of space required, the upper limit of the number of pictures that can be stored is only a question of memory capacity, and it is possible to produce cheaper, more modest one hundred word devices, or more expensive devices containing even one thousand picture word connections.

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Due to the low resolution, an advantage is that many objects which are different in some respects, but which are similar in profile, are forced into one group, but the aim is not to recognise a type, or the brand of a motor vehicle, so that differentiating is satisfactory.

5 Another advantage that has to be mentioned is that the weight of the device is low, as is its consumption, its price is modest, affordable by all, its covering is protected against rain, its sensitivity even in dusk is satisfactory, and it ensures stable operation even in environmental light of 0.2 lux.

10 It is also important to emphasise the advantageous feature that technically a resolution may be attained with which letters and characters may be "read out", and with this a new area of use opens, not only for the blind, but also for those with poor sight.

15 Another advantage is that the device does not operate by answering questions, but operates in every case when an object comes into the field of vision of the camera, and this ensures automatic navigation for blind people. Still another important advantage is that due to the positioning of the camera on the head, in a spectacle frame, the blind person receives information on the objects in front of him/her in a band according to the position of the body, that is, the head, which even in the basic position essentially makes the position of obstacles  
20 with respect to the position of the blind person perceivable.

It is practical for the device of the set equipment to be fitted to the arms of a spectacles frame (also ensuring its aesthetic production) so that, in accordance with the head movement-seeing psychological effect, it is turned in the direction of "viewing" and so the optical sensor  
25 of the device fixed in this way sees a real, black and white picture. A microcomputer transforms the produced series of signals into digital form with analogue-to digital conversion, stores it, and then compares it with the bit pictures of signal forms belonging to an average of one hundred pictures recorded during programming. In accordance with the result of the

comparison, an expression is selected that was associated with the picture during programming, and the name of the picture is read out through miniature loudspeakers.

### Brief Description of Drawings

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In connection with the example the invention is presented in more detail on the basis of drawings in which:

Figure 1 is an outline sketch of a version of the device,

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Figure 2 is a picture showing the video signal mapping, and

Figure 3 is a flow diagram of the steps of the operating program.

### Disclosure of Invention

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Figure 1 shows the outline of the important elements of the device. The CCD camera 1 provides the basic signal of the device, which the joining module 2 edits and adjusts in amplitude for the microprocessor 3 having an external bus 3b.

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The sample-taking subroutine of the processing program stores the video signal coming into the analogue input 3a of the microprocessor 3 in 64 pieces, 8 bit words – as shown in Figure 2 – as one block in the working register. This low resolution gives the device the advantage that it sees quite a lot of similar objects to be the same. The procedure can continue here in two directions.

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In the case that we are in the “learning” status, we connect the writing unit 8 temporarily to the data transfer input 3d of the microprocessor 3 and then it writes the contents of a given block into the picture memory 4, and provides it with a serial number which it then uses as an index during the search process. At the same time, it stores the short

describing expression arriving through the microphone 9 into the sound memory 5.

5 If we are in the recognition or user status, the program – the block outline of which is shown by Figure 3 – takes the blocks from the picture memory 4 in line, compares them with the blocks to be found in the working register, and then, in the case of identity on the basis of the index belonging to the given block, the expression belonging to the index is selected from the sound memory 5, transferred to the output register, and then “sent” out through the output 3c to the amplifier 6, and then to the loudspeaker 7. The process is repeated like this, and then, 10 if there is no identifiable block, a message “unknown obstacle” is heard. In the interest of reliable identification the picture needs to be a standing picture for one second.

Deriving from the video signal frequency and the type of microprocessor and its clock pulse (100 MHz), approximately ten measurements take place in one second, and this is 15 enough of a guarantee for reliable recognition. This value is close to the human recognising ability, e.g. the running into one another of pictures while you shake your head.

While preferred forms and arrangements have been shown in illustrating the invention, it is to be understood that various changes and modifications may be made without departing 20 from the spirit and scope of this disclosure.